

Radial, Molded, COG Dielectric, 50 – 200 VDC (Commercial Grade)

Overview

KEMET's epoxy molded radial through-hole ceramic capacitors in COG dielectric feature a 125°C maximum operating temperature. The Electronics Industries Alliance (EIA) characterizes COG dielectric as a Class I "stable" material. Components of this classification are temperature compensating and are suited for resonant circuit applications or those where Q and stability of

capacitance characteristics are required. COG exhibits no change in capacitance with respect to time and voltage and boasts a negligible change in capacitance with reference to ambient temperature. Capacitance change is limited to ± 30 ppm/°C from -55°C to +125°C. These devices meet the flame test requirements outlined in UL Standard 94 V-0.

Benefits

- Radial through-hole form factor
- Molded case
- -55°C to +125°C operating temperature range
- DC voltage ratings of 50 V, 100 V and 200 V
- Capacitance offerings ranging from 1.0 pF up to 0.18 μ F
- Available capacitance tolerances of ± 0.5 pF, $\pm 1\%$, $\pm 2\%$, $\pm 5\%$, and $\pm 10\%$
- No piezoelectric noise
- Extremely low ESR and ESL
- High thermal stability
- High ripple current capability
- No capacitance change with respect to applied rated DC voltage
- Negligible capacitance change with respect to temperature from -55°C to +125°C
- No capacitance decay with time
- Non-polar device, minimizing installation concerns
- SnPb-plated lead finish (60/40)
- 100% pure matte tin-plated lead finish option available upon request (RoHS)
- Encapsulation meets flammability standard UL 94 V-0



Ordering Information

| C | 052 | C | 272 | F | 2 | G | 5 | T | A | 7303 |
|---------|--------------------------|-----------------------|--|---|---------------------|------------|-------------------|---|--------------|--|
| Ceramic | Style/ Size | Specification/ Series | Capacitance Code (pF) | Capacitance Tolerance ¹ | Rated Voltage (VDC) | Dielectric | Design | Lead Finish ² | Failure Rate | Packaging/ Grade (C-Spec) ³ |
| | 052 062 512 522 | C = Standard | Two significant digits and number of zeros Use 9 for 1.0 – 9.9 pF Use 8 for 0.5 – .99 pF ex. 2.2 pF = 229 ex. 0.5 pF = 508 | D = ± 0.5 pF F = $\pm 1\%$ G = $\pm 2\%$ J = $\pm 5\%$ K = $\pm 10\%$ | 1 = 100 2 = 200 | G = COG | 5 = Multilayer | T = 100% Matte Sn C = SnPb (60/40) | A = N/A | Blank = Bulk 7301 = 12" Reel 7303 = 12" Reel 7293 = Ammo Pack |

¹ Additional capacitance tolerance offerings may be available. Contact KEMET for details.

² Lead materials and finishes:

Standard: 60% tin (Sn)/40% lead (Pb) finish with 100% copper core ("C" designation).

Optional (C052 and C062 only): 100% matte tin (Sn) with nickel (Ni) underplate and steel core ("T" designation).

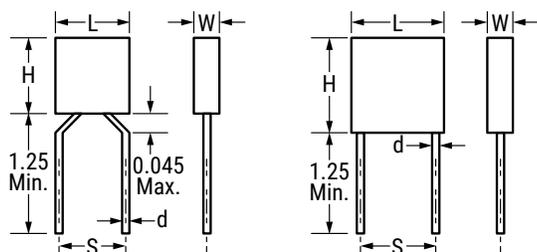
Alternative lead materials and finishes may be available. Contact KEMET for details.

³ Reeling options:

C-Spec 7301: Recommended for straight lead configuration part types.

C-Spec 7301: Recommended for formed (bent) lead configuration part types.

Dimensions – Inches (Millimeters)



| Series | Style/ Size | S Lead Spacing | L Length | H Height | T Thickness | LD Lead Diameter | LL Lead Length Minimum |
|--------|----------------|---------------------------|---------------------------|---------------------------|--------------------------|--|------------------------------|
| C05X | 052/ 056 | 0.20±0.015 (5.08±0.38) | 0.19±0.01 (4.83±0.25) | 0.19±0.01 (4.83±0.25) | 0.09±0.01 (2.29±0.25) | 0.025+0.004/-0.002 (0.635+0.102/-0.051) | 1.25 (31.75) |
| C06X | 062/ 066 | | 0.29±0.01 (7.37±0.25) | 0.29±0.01 (7.37±0.25) | 0.09±0.01 (2.29±0.25) | | |
| C5XX | 512 | 0.40±0.02 (10.16±0.51) | 0.48±0.02 (12.19±0.51) | 0.48±0.02 (12.19±0.51) | 0.14±0.01 (3.56±0.25) | | |
| | 522 | | 0.48±0.02 (12.19±0.51) | 0.48±0.02 (12.19±0.51) | 0.24±0.01 (6.10±0.25) | | |

Applications

Typical applications include critical timing, tuning, circuits requiring low loss, circuits with pulse, high current, decoupling, bypass, filtering, transient voltage suppression, blocking and energy storage.

Application Notes

These devices are not recommended for use in overmold applications and/or processes

Qualification/Certification

Commercial Grade products are subject to internal qualification. Details regarding test methods and conditions are referenced in Table 2, Performance & Reliability.

Environmental Compliance

Devices with standard lead finish option of 60% tin (Sn)/40% lead (Pb) do not meet RoHS criteria.
 Devices with 100% matte tin (Sn) lead finish option are RoHS Compliant (C052 & C062 only).

Electrical Parameters/Characteristics

| Item | Parameters/Characteristics |
|--|---|
| Operating Temperature Range | -55°C to +125°C |
| Capacitance Change with Reference to +25°C and 0 VDC Applied (TCC) | ±30 ppm/°C |
| Aging Rate (Maximum % Cap Loss/Decade Hour) | 0% |
| Dielectric Withstanding Voltage | 250% of rated voltage (5±1 seconds and charge/discharge not exceeding 50 mA) |
| Dissipation Factor (DF) Maximum Limit at 25°C | 0.1% |
| Insulation Resistance (IR) Limit at 25°C | 1,000 megohm microfarads or 100 GΩ (Rated voltage applied for 120±5 seconds at 25°C) |

To obtain IR limit, divide MΩ-μF value by the capacitance and compare to GΩ limit. Select the lower of the two limits.

Capacitance and dissipation factor (DF) measured under the following conditions:

1 MHz ±100 kHz and 1.0 V_{rms} ±0.2 V if capacitance ≤ 1,000 pF

1 kHz ±50 Hz and 1.0 V_{rms} ±0.2 V if capacitance > 1,000 pF

Note: When measuring capacitance it is important to ensure the set voltage level is held constant. The HP4284 and Agilent E4980 have a feature known as Automatic Level Control (ALC). The ALC feature should be switched to "ON."

Post Environmental Limits

| High Temperature Life, Biased Humidity, Moisture Resistance | | | | |
|---|------------------|-------------------|--------|-------------------|
| Dielectric | Rated DC Voltage | Capacitance Value | DF (%) | Capacitance Shift |
| COG | All | All | 0.5 | 0.3% or ±0.25 pF |

Table 1A – C052 Style/Size (0.20" Lead Spacing), Capacitance Range Waterfall

| C052 Style/Size (0.20" Lead Spacing) | | | | |
|--------------------------------------|---|--|-----|-----|
| Rated Voltage (VDC) | | 50 | 100 | 200 |
| Voltage Code | | 5 | 1 | 2 |
| Capacitance | Capacitance Tolerance | Capacitance Code (Available Capacitance) | | |
| 1pF | D = ±0.5 pF | 109 | 109 | 109 |
| 1.5pF | | 159 | 159 | 159 |
| 2.2pF | | 229 | 229 | 229 |
| 2.7pF | | 279 | 279 | 279 |
| 3.3pF | | 339 | 339 | 339 |
| 3.9pF | | 399 | 399 | 399 |
| 4.7pF | | 479 | 479 | 479 |
| 5.6pF | | 569 | 569 | 569 |
| 6.8pF | | 689 | 689 | 689 |
| 8.2pF | | 829 | 829 | 829 |
| 10pF | J = ±5% K = ±10% | 100 | 100 | 100 |
| 12pF | | 120 | 120 | 120 |
| 15pF | | 150 | 150 | 150 |
| 18pF | | 180 | 180 | 180 |
| 22pF | | 220 | 220 | 220 |
| 27pF | G = ±2% J = ±5% K = ±10% | 270 | 270 | 270 |
| 33pF | | 330 | 330 | 330 |
| 39pF | | 390 | 390 | 390 |
| 47pF | | 470 | 470 | 470 |
| 56pF | | 560 | 560 | 560 |
| 68pF | F = ±1% G = ±2% J = ±5% K = ±10% | 680 | 680 | 680 |
| 82pF | | 820 | 820 | 820 |
| 100pF | | 101 | 101 | 101 |
| 120pF | | 121 | 121 | 121 |
| 150pF | | 151 | 151 | 151 |
| 180pF | | 181 | 181 | 181 |
| 220pF | | 221 | 221 | 221 |
| 270pF | | 271 | 271 | 271 |
| 330pF | | 331 | 331 | 331 |
| 390pF | | 391 | 391 | 391 |
| 470pF | | 471 | 471 | 471 |
| 560pF | | 561 | 561 | 561 |
| 680pF | | 681 | 681 | 681 |
| 820pF | | 821 | 821 | 821 |
| 1000pF | | 102 | 102 | 102 |
| 1200pF | | 122 | 122 | 122 |
| 1500pF | | 152 | 152 | 152 |
| 1800pF | | 182 | 182 | 182 |
| 2200pF | | 222 | 222 | 222 |
| 2700pF | | 272 | 272 | 272 |
| 3300pF | | 332 | 332 | 332 |
| 2700pF | | 272 | 272 | 272 |
| 3300pF | | 332 | 332 | 332 |
| 3900pF | | 392 | 392 | 392 |
| 4700pF | | 472 | 472 | 472 |
| Rated Voltage (VDC) | | 50 | 100 | 200 |
| Voltage Code | | 5 | 1 | 2 |

Table 1B – C062 Style/Size (0.20" Lead Spacing), Capacitance Range Waterfall

| C062 Style/Size (0.20" Lead Spacing) | | | | | |
|--------------------------------------|---|--|-----|-----|--|
| Rated Voltage (VDC) | | 50 | 100 | 200 | |
| Voltage Code | | 5 | 1 | 2 | |
| Capacitance | Capacitance Tolerance | Capacitance Code (Available Capacitance) | | | |
| 3300pF | F = ±1% G = ±2% J = ±5% K = ±10% | 332 | 332 | 332 | |
| 3900pF | | 392 | 392 | 392 | |
| 4700pF | | 472 | 472 | 472 | |
| 5600pF | | 562 | 562 | 562 | |
| 6800pF | | 682 | 682 | 682 | |
| 8200pF | | 822 | 822 | 822 | |
| 0.01μF | | 103 | 103 | 103 | |
| 0.012μF | | 123 | 123 | | |
| 0.015μF | | 153 | 153 | | |
| 0.018μF | | 183 | 183 | | |
| 0.022μF | | 223 | 223 | | |
| Rated Voltage (VDC) | | 50 | 100 | 200 | |
| Voltage Code | | 5 | 1 | 2 | |

Table 1C – C512 Style/Size (0.40" Lead Spacing), Capacitance Range Waterfall

| C512 Style/Size (0.40" Lead Spacing) | | | | |
|--------------------------------------|---|--|-----|-----|
| Rated Voltage (VDC) | | 50 | 100 | 200 |
| Voltage Code | | 5 | 1 | 2 |
| Capacitance | Capacitance Tolerance | Capacitance Code (Available Capacitance) | | |
| 0.012μF | F = ±1% G = ±2% J = ±5% K = ±10% | 123 | 123 | 123 |
| 0.015μF | | 153 | 153 | 153 |
| 0.018μF | | 183 | 183 | 183 |
| 0.022μF | | 223 | 223 | 223 |
| 0.027μF | | 273 | 273 | 273 |
| 0.033μF | | 333 | 333 | 333 |
| 0.039μF | | 393 | 393 | 393 |
| 0.047μF | | 473 | 473 | 473 |
| 0.056μF | | 563 | 563 | 563 |
| 0.068μF | | 683 | 683 | 683 |
| 0.082μF | | 823 | 823 | |
| 0.1μF | | 104 | 104 | |
| Rated Voltage (VDC) | | 50 | 100 | 200 |
| Voltage Code | | 5 | 1 | 2 |

Table 1D – C522 Style/Size (0.40" Lead Spacing), Capacitance Range Waterfall

| C522 Style/Size (0.40" Lead Spacing) | | | | |
|--------------------------------------|---|--|-----|-----|
| Rated Voltage (VDC) | | 50 | 100 | 200 |
| Voltage Code | | 5 | 1 | 2 |
| Capacitance | Capacitance Tolerance | Capacitance Code (Available Capacitance) | | |
| 0.082μF | F = ±1% G = ±2% J = ±5% K = ±10% | 823 | 823 | 823 |
| 0.1μF | | 104 | 104 | 104 |
| 0.12μF | | 124 | 124 | |
| 0.15μF | | 154 | 154 | |
| 0.18μF | | 184 | 184 | |
| Rated Voltage (VDC) | | 50 | 100 | 200 |
| Voltage Code | | 5 | 1 | 2 |

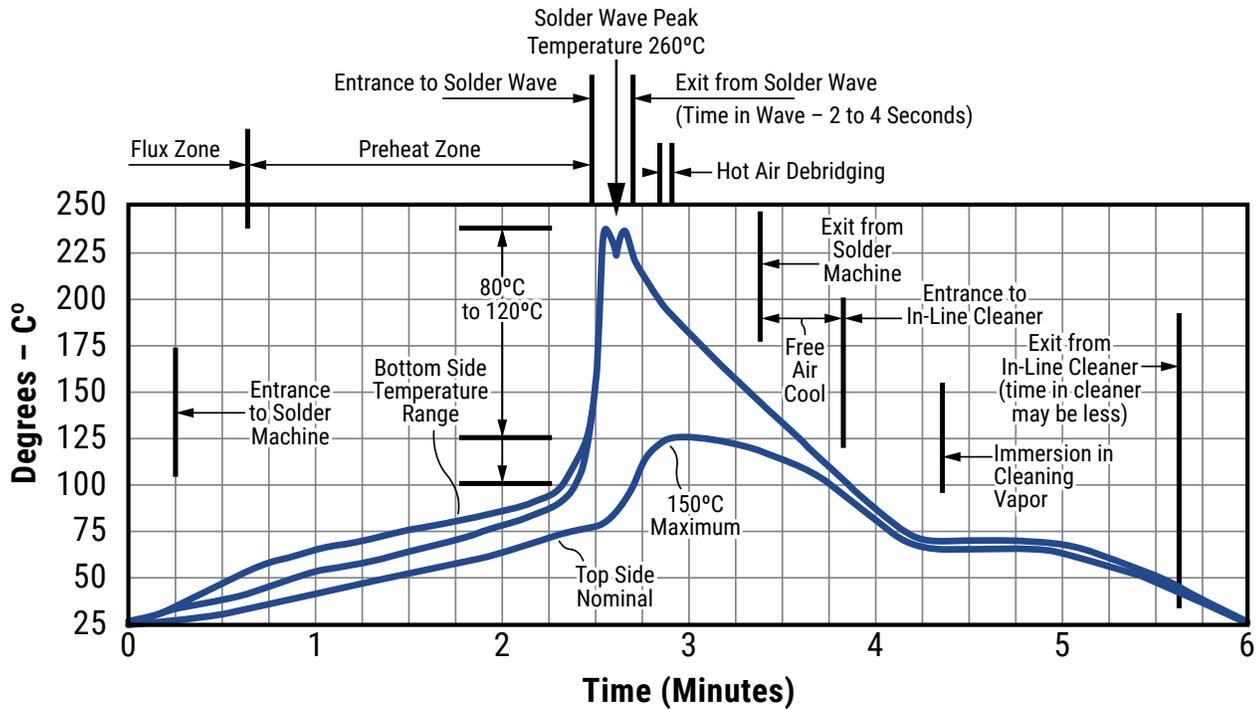
Soldering Process

Recommended Soldering Technique:

- Solder Wave
- Hand Soldering (Manual)

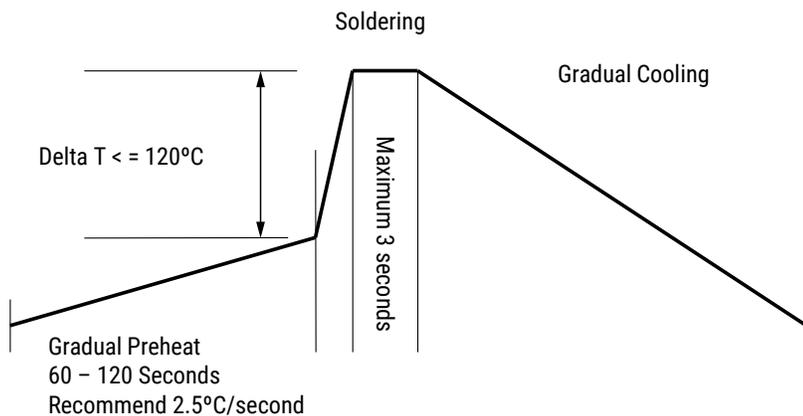
Recommended Soldering Profile:

- Optimum Wave Solder Profile



- Hand Soldering (Manual)

Manual Solder Profile with Pre-heating



KEMET recommends following the guidelines and techniques outlined in technical bulletins F2103 and F9207.

Table 2 – Performance & Reliability: Test Methods and Conditions

| Stress | Reference | Test or Inspection Method |
|------------------------------|---------------------------------|--|
| Solderability | J-STD-002 | Magnification 50 X. Conditions: |
| | | a) Method B, 4 hours at 155°C, dry heat at 235°C |
| | | b) Method B at 215°C category 3 |
| | | c) Method D, category 3 at 260°C |
| Temperature Cycling | JESD22 Method JA-104 | 1,000 cycles (-55°C to +125°C), Measurement at 24 hours. +/-2 hours after test conclusion. |
| Biased Humidity | MIL-STD-202 Method 103 | Load Humidity: 1,000 hours 85°C/85% RH and Rated Voltage. Add 100 K ohm resistor. Measurement at 24 hours. +/-2 hours after test conclusion. |
| | | Low Volt Humidity: 1,000 hours 85°C/85% RH and 1.5 V. Add 100 K ohm resistor. Measurement at 24 hours. +/-2 hours after test conclusion. |
| Moisture Resistance | MIL-STD-202 Method 106 | t = 24 hours/cycle. Steps 7a and 7b not required. Unpowered. Measurement at 24 hours. +/-2 hours after test conclusion. |
| Thermal Shock | MIL-STD-202 Method 107 | -55°C/+125°C. Note: Number of cycles required – 300. Maximum transfer time – 20 seconds. Dwell time – 15 minutes. Air – Air. |
| High Temperature Life | MIL-STD-202 Method 108 /EIA-198 | 1,000 hours at 125°C (85°C for X5R, Z5U and Y5V) with 2 X rated voltage applied. |
| Storage Life | MIL-STD-202 Method 108 | 150°C, 0 VDC, for 1,000 hours. |
| Vibration | MIL-STD-202 Method 204 | 5 g for 20 minutes, 12 cycles each of 3 orientations. Note: Use 8"X5" PCB .031" thick 7 secure points on one long side and 2 secure points at corners of opposite sides. Parts mounted within 2" from any secure point. Test from 10 – 2,000 Hz. |
| Resistance to Soldering Heat | MIL-STD-202 Method 210 | Condition B. No pre-heat of samples. Note: single wave solder – procedure 2. |
| Terminal Strength | MIL-STD-202 Method 211 | Conditions A (2.3 kg or 5 lbs) |
| Mechanical Shock | MIL-STD-202 Method 213 | Figure 1 of Method 213, Condition F. |
| Resistance to Solvents | MIL-STD-202 Method 215 | Add aqueous wash chemical, OKEM Clean or equivalent. |

Storage & Handling

Ceramic chip capacitors should be stored in normal working environments. While the chips themselves are quite robust in other environments, solderability will be degraded by exposure to high temperatures, high humidity, corrosive atmospheres, and long term storage. In addition, packaging materials will be degraded by high temperature—reels may soften or warp, and tape peel force may increase. KEMET recommends that maximum storage temperature not exceed 40°C, and maximum storage humidity not exceed 70% relative humidity. Temperature fluctuations should be minimized to avoid condensation on the parts, and atmospheres should be free of chlorine and sulfur bearing compounds. For optimized solderability, chip stock should be used promptly, preferably within 1.5 years of receipt.

Packaging Details

| Lead Spacing | Component Pitch (P1) |
|---------------|----------------------|
| 0.100 (2.54) | 5.08 |
| 0.200 (5.08) | 3.81 |
| 0.400 (10.16) | 7.62 |
| 0.170 (4.32) | |
| 0.220 (5.59) | |
| 0.275 (6.98) | |
| 0.300 (7.62) | |
| 0.375 (9.52) | |
| 0.475 (12.06) | |
| 0.575 (14.60) | |
| 0.675 (17.14) | |

Packaging Quantities

| Style/Size | Standard Bulk Quantity | Ammo Pack Quantity Maximum | Reel Quantity Maximum (12" Reel) |
|------------|------------------------|----------------------------|----------------------------------|
| 052 | 100/Bag | 2000 | 2000 |
| 062 | 100/Bag | 1500 | 1500 |
| 512 | See Note ¹ | N/A | N/A |
| 522 | | | |

¹ Quantity varies. For further details, please contact KEMET.

Marking



KEMET Electronics Corporation Sales Offices

For a complete list of our global sales offices, please visit www.kemet.com/sales.

Disclaimer

All product specifications, statements, information and data (collectively, the "Information") in this datasheet are subject to change. The customer is responsible for checking and verifying the extent to which the Information contained in this publication is applicable to an order at the time the order is placed.

All Information given herein is believed to be accurate and reliable, but it is presented without guarantee, warranty, or responsibility of any kind, expressed or implied.

Statements of suitability for certain applications are based on KEMET Electronics Corporation's ("KEMET") knowledge of typical operating conditions for such applications, but are not intended to constitute – and KEMET specifically disclaims – any warranty concerning suitability for a specific customer application or use. The Information is intended for use only by customers who have the requisite experience and capability to determine the correct products for their application. Any technical advice inferred from this Information or otherwise provided by KEMET with reference to the use of KEMET's products is given gratis, and KEMET assumes no obligation or liability for the advice given or results obtained.

Although KEMET designs and manufactures its products to the most stringent quality and safety standards, given the current state of the art, isolated component failures may still occur. Accordingly, customer applications which require a high degree of reliability or safety should employ suitable designs or other safeguards (such as installation of protective circuitry or redundancies) in order to ensure that the failure of an electrical component does not result in a risk of personal injury or property damage.

Although all product-related warnings, cautions and notes must be observed, the customer should not assume that all safety measures are indicated or that other measures may not be required.